Dynamical magnetic properties of Cr in an Fe/Cr(110) multilayer

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It is of fundamental importance to quantify the dynamical properties of the Cr magnetic moments in thin Cr films to understand the origin of biquadratic interlayer coupling in Fe/Cr multilayers. Recently, perturbed angular correlation experiments have shown that the origin of the biquadratic coupling in Fe/Cr multilayers is related to the presence of fluctuating Cr magnetic moments in the Cr spacer [1]. Neutron diffraction experiments on similar Fe/Cr multilayers show that the presence of biquadratic coupling between the Fe layers is connected to the presence of the commensurate antiferromagnetic phase in the Cr spacer [2]. The results obtained by both techniques demands a better understanding of the magnetic properties of thin Cr films. For this purpose the magnetic phase diagram of a 26nm thick Cr spacer in an Fe/Cr(110) multilayer is studied by perturbed angular correlation spectroscopy. Previously, neutron diffraction experiments of the Cr spacer revealed an incommensurate spin-density-wave below 200K [3]. Between 200K and 300K, a transition from the incommensurate spin-density-wave to the commensurate antiferromagnetic phase is observed [3]. The commensurate to paramagnetic phase transition occurs at 450K [3]. The perturbed angular correlation spectroscopy results confirm the magnetic phase diagram of the Cr spacer identified by neutron diffraction [3,4]. Additionally, the perturbed angular correlation study identifies strong dynamics when the commensurate antiferromagnetic ordering is present in the Cr spacer. The Cr magnetic moments in the Cr spacer fluctuate with frequencies in the MHz range when the transition from the commensurate state to the paramagnetic state takes place. An activation energy of 109(15)meV is obtained from the experiment [4]. The perturbed angular correlation study shows that strong fluctuations dominate the perturbed angular correlation spectrum when the commensurate antiferromagnetic phase is present in the Cr spacer and further supports the proposition that the origin of the biquadratic interlayer coupling in Fe/Cr multilayers is related to the dynamics of the Cr magnetic moments in the Cr spacer.

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